Executive Summary

ES.1 WHAT INFORMATION IS PRESENTED IN THIS REPORT?

This report presents the United States (U.S.) Environmental Protection Agency's (EPA) latest estimates of national emissions for criteria air pollutants: carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOC), sulfur dioxide (SO_2), particulate matter (PM) less than 10 microns in aerodynamic diameter (PM_{10}), particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), and lead (Pb). In addition, estimates of ammonia (NH_3), an important precursor for secondarily formed particles, are also presented. Estimates are presented for the years 1900 to 1998. Estimates for three criteria pollutants, NO_x, SO_2, and VOC, have been extrapolated back to 1900. Criteria pollutants are those for which ambient air standards have been set, based on established criteria for risk to human health and/or environmental degradation.

Data on emissions of hazardous air pollutants (HAPs), or air toxics, greenhouse gases (carbon dioxide [CO_2], methane [CH_4], nitrous oxide [N_2O], hydrofluorocarbons {HFCs], perfluorocarbons (PFCs), and sulfur hexafluoride [SF_6]), and biogenic sources are also included in this report for the United States. As a point of comparison, data for Canada for 1995 and for Europe for 1996 are presented for the criteria air pollutants.

Figures ES-1 and ES-2 present the long-term trends in the criteria air pollutant emissions from 1900 through 1998. Most of the criteria air pollutant emission levels peaked around 1970. PM_{10} emissions peaked earlier (around 1950) since smoke and particulates were the first pollutants to be regulated. Between 1970 and 1998 emissions for all criteria pollutants have generally declined (except for NO_x), even though vehicle miles traveled (VMT) and gross domestic product (GDP) increased. For the last 2 years, SO_2 has shown a small increase in emissions. These air pollution decreases are attributable to the Clean Air Act (CAA) regulations beginning in 1970 and continuing into the 1990s. (Intermittent economic recession and improved manufacturing practices have also played a role.) Although not shown in these figures, the trend in $PM_{2.5}$ mirrors that of PM_{10} over the period that estimates have been made for $PM_{2.5}$ (1990-1998). NH_3 has shown a modest increase over this same time period.

ES.2 WHAT ARE THE CURRENT EMISSION LEVELS?

Tables ES-1 and ES-2 present the most current emission estimates for the criteria and other air pollutants in the United States. U.S. criteria pollutant emissions decreased for CO, VOC, and NO_x, and increased for Pb, SO_2, and PM_{10} from the previous year. The increase in SO_2 emission estimates is a result of a modest increase in emissions in the electric utility and industrial process sectors, probably fueled by the strong economy. The reduction in CO and VOC emissions results from a sharp decrease in emissions from forest wildfires, as well as a decrease in mobile source emissions as a result of the use of new fuels (reformulated gasoline, oxygenated fuels, and lower Reid vapor pressures [RVP]). Particulate fugitive dust emissions from construction sources, paved roads, and unpaved roads increased due to the increases in construction and VMT. The most recent available Canadian data for 1995 and Europe for 1996 are summarized in Table ES-3.

A description of those source categories whose methods used for estimating CO, NO_x, VOC, SO_2, PM_{10}, $PM_{2.5}$, NH_3, and Pb changed during the last year can be found in Chapter 5 of this report, while information on methods that did not change can be found in the National Air Pollutant Emission *Trends* Procedures Document.[1]

ES.3 WHAT ARE THE TRENDS IN POLLUTANT EMISSIONS?

The level and composition of economic activity in the nation, demographic influences, meteorological conditions, and regulatory efforts to control emissions affect the trends in criteria air pollutant emissions. The emissions resulting from these economic, demographic, and regulatory influences are presented in Figures ES-1 and ES-2. The changes in emissions are presented in Table ES-4 for several time periods. Up until the 1950s, the greatest influence on emissions were economic and demographic. Emissions grew as the economy and population increased; emissions declined in periods of economic recession. Dramatic declines in emissions in the 1930s were due to the Great Depression. More recent recession in the mid/late-1970s (largely a result from disruptions in the world oil markets) and early 1990s also led to decreases in emissions.

Emissions also increase as a result of a shift in the demand for various products. For example, the tremendous increase in demand for refined petroleum products, especially motor gasoline after World War II, increased emissions associated with petroleum refining and on-road vehicles. Increased economic production as a result of World War II raised emissions to levels higher than those of the pre-Depression Era. The declines in the 1940s through 1970s in residential wood combustion resulted from the abundant supply, low relative prices, and convenience of fossil fuel-generated electricity.

In the 1950s the States issued air pollution statutes generally targeted toward smoke and particulate emissions. It was not until passage of the CAA as amended in 1970 (Congress passed the original CAA in 1963) that major strides were made in reducing air pollution. The 1970 Amendments created the EPA and charged it with three major tasks: 1) set National Ambient Air Quality Standards (NAAQS); 2) develop motor vehicle emission standards; and 3) set new source performance standards (NSPS). As a result of these standards, CO, VOC, SO_2, and Pb emissions were reduced in the mid-1970s.

The Clean Air Act Amendments of 1990 (CAAA) are beginning to effect emission levels. For some source categories (such as non-road engines), standards began in 1996, but some significant emission reductions are not expected until after the year 2000. The robust U.S. economy in the late 1990s has provided a slight increase in emissions in some source sectors, although the influence of these increases has been largely offset by regulatory programs.

Some emission sources such as wildfires and fugitive dust have been influenced more by meteorological conditions than economic forces. Controls to reduce fugitive dust emissions resulting from the CAAA are beginning to take effect, but are only applied in the PM nonattainment areas (NAAs). The amount of land burned in wildfires varies greatly from year-to-year. Overall emission reductions from wildfires are a result of the U.S. Department of Agriculture's (USDA) Forest Service support of state efforts in fire prevention and early control. For example, in the year 1910, 5,201 fires burned approximately 5 million acres of land, whereas in the year 1990, 11,950 fires burned only one-third of a million acres of land.

More details on the effects of economic, demographic, and regulatory forces on emission levels are explained in Chapter 3.

ES.4 REFERENCES

1. "National Air Pollutant Emission Trends Procedures Document, 1900-1996," EPA-454/R-98-008, U.S. Environmental Protection Agency. May 1998.

2. "Historic Emissions of Sulfur and Nitrogen Oxides in the United States from 1900 to 1980," EPA-600/7-85-009a and b, U.S. Environmental Protection Agency, Cincinnati, OH. April 1985.

3. "Historic Emissions of Volatile Organic Compounds in the United States from 1900 to 1985," EPA-600/7-88-008a, U.S. Environmental Protection Agency, Cincinnati, OH. May 1988.

Table ES-1. 1997 and 1998 National Annual Emission Estimates for Criteria Air Pollutants
(million short tons)

Pollutant	Emissions 1997	1998
Anthropogenic Emissions		
Carbon Monoxide	94.41	89.45
Lead (thousand short tons)	3.95	3.97
Nitrogen Oxides	24.82	24.45
Particulate Matter (PM_{10})	34.23	34.74
Miscellaneous and Fugitive dust	30.08	30.90
Nonfugitive dust	4.15	3.84
Sulfur Dioxide	19.62	19.65
Volatile Organic Compounds	18.88	17.92
Biogenic Emissions		
Volatile Organic Compounds	28.19	NA
Nitric Oxide	1.53	NA

Table ES-2. 1998 National Annual Emission Estimates for $PM_{2.5}$, Ammonia, and 1990-1993 Hazardous Air Pollutants
(million short tons)

Pollutant	Emissions
Particulate Matter ($PM_{2.5}$)	8.38
Miscellaneous and Fugitive dust	5.46
Nonfugitive dust	2.92
Ammonia	4.94
Hazardous Air Pollutants	5.92

Table ES-3. Annual Criteria Air Pollutant Emission Estimates for Canada (1995) and Europe (1996)
(million short tons)

Pollutant	Canada	Europe
Carbon Monoxide	18.89	55.53
Nitrogen Oxides	2.72	15.31
Total Particulate Matter	17.29	NA
Sulfur Dioxide	2.93	18.53
Volatile Organic Compounds	3.94	16.09

Table ES-4. Percentage Change in National Emissions

Year	Carbon Monoxide	Nitrogen Oxides	Volatile Organic Compounds	Sulfur Dioxide	Particulate Matter (PM_{10})*	Miscellaneous and Fugitive Dust**	Lead
1900 to 1998	NA***	-840	-111	-97	NA	NA	NA
1940 to 1998	5	-232	-4	2	76	NA	NA
1970 to 1998	31	-17	42	37	71	NA	98
1988 to 1998****	25	-1	26	15	26	45	44
1990 to 1998	9	-2	14	17	15	-26	20
1997 to 1998	5	2	5	0	7	-3	-1

Note(s): * PM_{10} emissions excluding miscellaneous and fugitive dust sources.
** Miscellaneous sources include agriculture and forestry, fugitive dust includes roads and construction, and natural sources include primarily geogenic wind erosion.
*** NA denotes not available. Negative percent change indicates an increase in emissions.
**** There are significant changes in fugitive dust emission methodology between the years 1989 and 1990.

Figure ES-1. Trend in National Emissions, NITROGEN OXIDES, VOLATILE ORGANIC COMPOUNDS, SULFUR DIOXIDE (1900 to 1998), and Directly Emitted PARTICULATE MATTER (PM_{10} [nonfugitive dust sources]; 1940 to 1998)

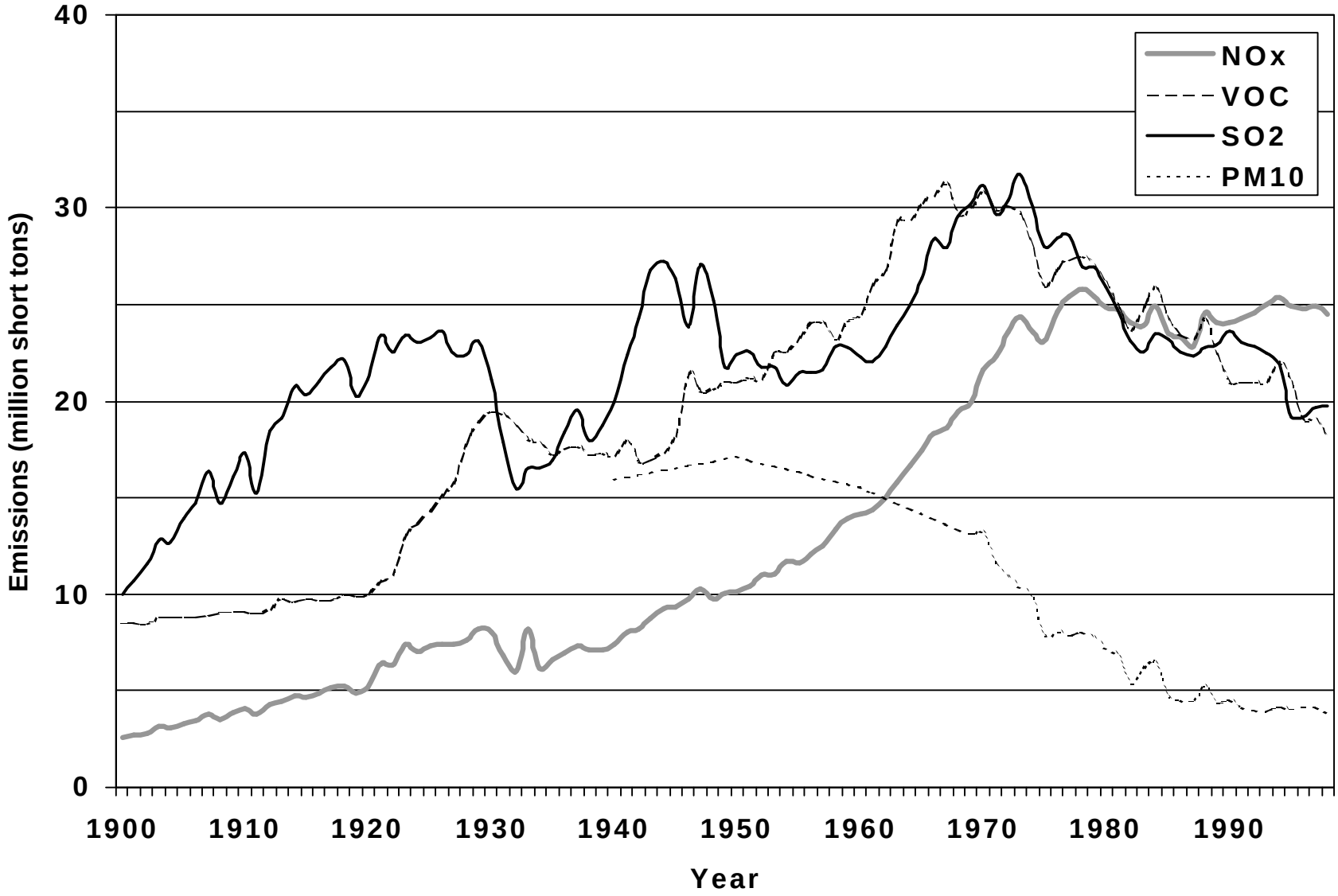

Figure ES-2. Trend in National Emissions, CARBON MONOXIDE